

031827

# 证 明

## CERTIFICATE

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国 际 申 请 号: PCT/CN03/00700

INTERNATIONAL APPLICATION NUMBER

国 际 申 请 日: 21 AUG 2003(21.08.03)

INTERNATIONAL FILING DATE

发 明 名 称 : ELECTRICAL CONNECTION AND COMPONENT ASSEMBLY

TITLE OF INVENTION

FOR CONSTITUTION OF A HARD DISK DRIVE

申 请 人: SAE MAGNETICE(H.K.)LTD

APPLICANT

中华人民共和国国家知识产权局局长  
COMMISSIONER OF THE STATE INTELLECTUAL PROPERTY  
OFFICE OF THE PEOPLE'S REPUBLIC OF CHINA

王景川

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SEPTEMBER 26, 2003

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REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

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International Application No. PCT/CN 03/00700	
International Filing Date 21 AUG 2003 (21.08.03)	
RO/CN 中华人民共和国国家知识产权局 PCT International Application	
Name of receiving Office and "PCT International Application"	
Applicant's or agent's file reference (if desired) (12 characters maximum) FPEL03150027	

Box No. I TITLE OF INVENTION <b>ELECTRICAL CONNECTION AND COMPONENT ASSEMBLY FOR CONSTITUTION OF A HARD DISK DRIVE</b>	
Box No. II APPLICANT	<input type="checkbox"/> This person is also inventor
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)	
SAE MAGNETICS (H. K.) LTD. SAE Tower, 38-42 Kwai Fung Crescent Kwai Chung N. T. Hong Kong Special Administrative Region, P. R. of China	
Telephone No.	
Facsimile No.	
Teleprinter No.	
Applicant's registration No. with the Office	
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This person is applicant for the purposes of:	<input checked="" type="checkbox"/> all designated States <input type="checkbox"/> all designated States except the United States of America <input type="checkbox"/> the United States of America only <input type="checkbox"/> the States indicated in the Supplemental Box
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WU, Lixing WINNERWAY INDUSTRIAL AREA, NANCHENG, DONGGUAN CITY, GUANGDONG PROVINCE, P.R. CHINA Zip Code: 511700	
This person is:	
<input type="checkbox"/> applicant only <input type="checkbox"/> applicant and inventor <input checked="" type="checkbox"/> inventor only (If this check-box is marked, do not fill in below.)	
Applicant's registration No. with the Office	
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<input checked="" type="checkbox"/> Further applicants and/or (further) inventors are indicated on a continuation sheet.	
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<input checked="" type="checkbox"/> agent <input type="checkbox"/> common representative	
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CHINA PATENT AGENT (H.K.) LTD. 22/F, Great Eagle Centre 23 Harbour Road, Wanchai Hong Kong Special Administrative Region The People's Republic of China	
Telephone No. (852)28284688	
Facsimile No. (852)28271018	
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Agent's registration No. with the Office	
<input type="checkbox"/> Address for correspondence: Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.	

Sheet No. ...2...

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ZHANG, Liujun  
WINNERWAY INDUSTRIAL AREA,  
NANCHENG, DONGGUAN CITY,  
GUANGDONG PROVINCE,  
P.R. CHINA Zip Code: 511700

This person is:

- applicant only  
 applicant and inventor  
 inventor only (If this check-box is marked, do not fill in below.)

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State (that is, country) of nationality:

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This person is:

- applicant only  
 applicant and inventor  
 inventor only (If this check-box is marked, do not fill in below.)

Applicant's registration No. with the Office

State (that is, country) of nationality:

State (that is, country) of residence:

This person is applicant for the purposes of:  all designated States  all designated States except the United States of America  the United States of America only  the States indicated in the Supplemental Box

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

This person is:

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State (that is, country) of nationality:

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Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

This person is:

- applicant only  
 applicant and inventor  
 inventor only (If this check-box is marked, do not fill in below.)

Applicant's registration No. with the Office

State (that is, country) of nationality:

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Sheet No. ...3...

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**Precautionary Designation Statement:** In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. (*Confirmation (including fees) must reach the receiving Office within the 15-month time limit.*)

Sheet No. . . . . . 4

**Box No. VI PRIORITY CLAIM**

The priority of the following earlier application(s) is hereby claimed:

Box No. VI PRIORITY CLAIM				
The priority of the following earlier application(s) is hereby claimed:				
Filing date of earlier application (day/month/year)	Number of earlier application	Where earlier application is:		
		national application: country or Member of WTO	regional application.* regional Office	international application: receiving Office
item (1)				
item (2)				
item (3)				
item (4)				
item (5)				

Further priority claims are indicated in the Supplemental Box.

The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) (*only if the earlier application was filed with the Office which for the purposes of this international application is the receiving Office*) identified above as:

all items     item (1)     item (2)     item (3)     item (4)     item (5)     other, see  
Supplemental Box

**Box No. VII. INTERNATIONAL SEARCHING AUTHORITY**

**Choice of International Searching Authority (ISA)** (if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):

ISA / CN

**Request to use results of earlier search; reference to that search (if an earlier search has been carried out by or requested from the International Searching Authority):**

**Box No. VIII DECLARATIONS**

The following declarations are contained in Boxes Nos. VIII (i) to (v) (mark the applicable check-boxes below and indicate in the right column the number of each type of declaration):

### Number of declarations

- Box No. VIII (i) Declaration as to the identity of the inventor
  - Box No. VIII (ii) Declaration as to the applicant's entitlement, as at the international filing date, to apply for and be granted a patent
  - Box No. VIII (iii) Declaration as to the applicant's entitlement, as at the international filing date, to claim the priority of the earlier application
  - Box No. VIII (iv) Declaration of inventorship (only for the purposes of the designation of the United States of America)
  - Box No. VIII (v) Declaration as to non-prejudicial disclosures or exceptions to lack of novelty

Sheet No. 5

## Box No. IX CHECK LIST; LANGUAGE OF FILING

This international application contains:	This international application is accompanied by the following item(s) (mark the applicable check-boxes below and indicate in right column the number of each item):		Number of items
(a) in paper form, the following number of sheets:			
request (including declaration sheets) : 5	<input checked="" type="checkbox"/> fee calculation sheet		: 1
description (excluding sequence listings and/or tables related thereto) : 6	<input checked="" type="checkbox"/> original separate power of attorney		: 1
claims : 3	<input type="checkbox"/> original general power of attorney		:
abstract : 1	<input type="checkbox"/> copy of general power of attorney; reference number, if any: .....		:
drawings : 7	<input type="checkbox"/> statement explaining lack of signature		:
<b>Sub-total number of sheets : 22</b>	<input type="checkbox"/> priority document(s) identified in Box No. VI as item(s): .....		:
sequence listings :	<input type="checkbox"/> translation of international application into (language): .....		:
tables related thereto :	<input type="checkbox"/> separate indications concerning deposited microorganism or other biological material		:
(for both, actual number of sheets if filed in paper form, whether or not also filed in computer readable form; see (c) below) : _____	<input type="checkbox"/> sequence listings in computer readable form (indicate type and number of carriers):		
<b>Total number of sheets : 22</b>	<input type="checkbox"/> (i) <input type="checkbox"/> copy submitted for the purposes of international search under Rule 13ter only (and not as part of the international application):		
(b) <input type="checkbox"/> only in computer readable form (Section 801(a)(i))	<input type="checkbox"/> (ii) <input type="checkbox"/> (only where check-box (b)(i) or (c)(i) is marked in left column) additional copies including, where applicable, the copy for the purposes of international search under Rule 13ter		
(i) <input type="checkbox"/> sequence listings	<input type="checkbox"/> (iii) <input type="checkbox"/> together with relevant statement as to the identity of the copy or copies with the sequence listings mentioned in left column		:
(ii) <input type="checkbox"/> tables related thereto	<input type="checkbox"/> 10. <input type="checkbox"/> tables in computer readable form related to sequence listings (indicate type and number of carriers):		
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(ii) <input type="checkbox"/> tables related thereto	<input type="checkbox"/> (iii) <input type="checkbox"/> together with relevant statement as to the identity of the copy or copies with the tables mentioned in left column		:
Type and number of carriers (diskette, CD-ROM, CD-R or other) on which are contained the	<input type="checkbox"/> 11. <input type="checkbox"/> other (specify): .....		:
<input type="checkbox"/> sequence listings: .....			
<input type="checkbox"/> tables related thereto: .....			
(additional copies to be indicated under items 9(ii) and/or 10(ii), in right column)			

Figure of the drawings which should accompany the abstract: Fig 4

Language of filing of the international application: EN

Box No. X SIGNATURE OF APPLICANT, AGENT OR COMMON REPRESENTATIVE  
*Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).*

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1. Date of actual receipt of the purported international application:	21 AUG 2003 (21.08.03)	
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:		
4. Date of timely receipt of the required corrections under PCT Article 11(2):		
5. International Searching Authority (if two or more are competent): ISA /	6. <input type="checkbox"/> Transmittal of search copy delayed until search fee is paid	

2. Drawings:

 received: not received:

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# PCT

## FEE CALCULATION SHEET Annex to the Request

Applicant's or agent's file reference

FPEL03150027

For receiving Office use only

International Application No.

PCT/CN 03/00700

21 AUG 2003

(21.08.03)

Applicant

SAE MAGNETICS (H.K.) LTD.

### CALCULATION OF PRESCRIBED FEES

1. TRANSMITTAL FEE . . . . .

CNY500

T

CNY1500

S

2. SEARCH FEE . . . . .

International search to be carried out by \_\_\_\_\_

(If two or more International Searching Authorities are competent to carry out the international search, indicate the name of the Authority which is chosen to carry out the international search.)

3. INTERNATIONAL FEE

#### Basic Fee

Where items (b) and/or (c) of Box No. IX apply, enter Sub-total number of sheets } 22  
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[b1] first 30 sheets . . . . . CHF650 [b1]

[b2] \_\_\_\_\_ x \_\_\_\_\_ = [b2]

number of sheets fee per sheet  
in excess of 30

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#### Designation Fees

The international application contains 1 designations.

1 x CHF140 = CHF140 [D]

number of designation fees amount of designation fee  
payable (maximum 5)

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CHF 790 [I]

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4. FEE FOR PRIORITY DOCUMENT (if applicable) . . . . .

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CHF 790.

CNY 2000.

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See Notes to the fee calculation sheet

## ELECTRICAL CONNECTION AND COMPONENT ASSEMBLY FOR CONSTITUTION OF A HARD DISK DRIVE

### Background Information

5

[0001] The present invention relates to magnetic hard disk drives. More specifically, the present invention relates to a method of electrically coupling a flexible circuit assembly to a circuit board.

[0002] Figure 1 provides an illustration of a typical disk drive. The typical disk 10 drive has a head gimbal assembly (HGA) configured to read from and write to a magnetic hard disk 101. The HGA and the magnetic hard disk 101 are mounted to the base 102 of a main board 103. The disk 101 is rotated relative to the base 102 by a spindle motor 104. The HGA typically includes an actuator arm 105 and a load beam 106. The HGA supports and positions a magnetic read/write slider 107 above the magnetic hard disk 101. The slider may contain transducers to perform the read/write function. The HGA is rotated relative to the base 102 along the axis of a pivot bearing assembly 108 by an actuator frame 109. The actuator frame 109 contains an actuator coil 110 driven by a magnet 111. A relay flexible printed circuit 112 connects a board unit 113 to the transducer of the magnetic read/write slider 107. The signal from the transducer is transmitted along the relay flexible printed circuit 112 via a printed circuit board (PCB) 114 coupled to the frame 109.

[0003] The flexible printed circuit assembly 112 can be electrically coupled to the PCB 114 using a number of different methods. Figure 2 provides an illustration of one method of electrically coupling the flexible circuit assembly 112 to the PCB 114 according to the prior art. A flexible substrate 201 of the flexible printed circuit assembly 112 is positioned above a circuit substrate 202 of the PCB 114. The circuit substrate 202 can be rigid or flexible. In this case, a bonding pad 203 is mounted on the circuit substrate 202 and electrically coupled to circuitry within the PCB 114. A connecting pad 204 is mounted on the flexible substrate 201 and

electrically coupled to circuitry within the flexible circuit assembly 112. The bonding pad 203 and connecting pad 204 are aligned. Then, a soldering bump 205 is placed upon the bonding pad 203 and the connecting pad 204. The soldering bump 205 can have a copper core 206. A heated tip 207 is then used to reflow the solder bumps 205. The tip 207 can be heated using a laser or ultrasonic energy. The tip 207 presses the flexible substrate 201 against the circuit substrate 202 for a set period of time, and the heat from the tip 207 melts the opposing solder bumps 205 together to form a bond. The copper cores 206 come into contact creating an electrical connection.

[0004] Figure 3 provides an illustration of an alternate method of electrically coupling the flexible circuit assembly 112 to the PCB 114 according to the prior art. The flexible substrate 201 of the flexible printed circuit assembly 112 is positioned above the circuit substrate 202 of the PCB 114. The bonding pad 203 is mounted on the circuit substrate 202 and electrically coupled to circuitry within the PCB 114. The connecting pad 204 is mounted on the flexible substrate 201 and electrically coupled to circuitry within the flexible circuit assembly 112. In this case, the bonding pad 203 and the connecting pad 204 are coated with gold. An anisotropic conductive film (ACF) is applied to the bonding pad 203. The bonding pad 203 and the connecting pad 204 are aligned. Then the heated tip 207 presses the flexible substrate 201 against the circuit substrate 202 for a set period of time. The heat from the tip 207 melts the ACF to the connecting pad 204 to form a bond.

[0005] The use of the laser-heated tip 207 requires a great deal of precision. Additionally the tools required in performing this method are also quite costly. The accuracy required in the alignment process also greatly reduces the efficiency of these bonding processes.

Brief Description Of The Drawings

[0006] Figure 1 provides an illustration of a typical disk drive.

[0007] Figure 2 provides an illustration of one method of electrically coupling the flexible circuit assembly to the PCB according to the prior art.

5 [0008] Figure 3 provides an illustration of an alternate method of electrically coupling the flexible circuit assembly to the PCB according to the prior art.

[0009] Figure 4 provides an illustration of one embodiment of a process for electrically coupling the flexible circuit assembly to the printed circuit board according to the present invention.

10 [0010] Figure 5 provides an illustration of an alternate embodiment of a process for electrically coupling the flexible circuit assembly to the PCB according to the present invention.

[0011] Figure 6 provides a cross-sectional illustration of one embodiment of the electrical connection of a hard disk drive according to the present invention.

15 [0012] Figure 7 provides a cross-sectional illustration of one embodiment of the electrical connection of an MP3 player according to the present invention.

Detailed Description

[0013] An electrical connection and a method of electrically coupling are disclosed. In one embodiment, a circuit substrate with a first set of circuitry has a bonding pad mounted to a surface of the circuit board. The bonding pad is electrically coupled to the first set of circuitry. A flexible circuit substrate with a second set of circuitry has a connecting pad mounted to a surface of the flexible circuit substrate facing the surface of the circuit board. The connecting pad is electrically coupled to the second set of circuitry. A ball of conductive material is mounted on the bonding pad. A clamping device presses the connecting pad to the ball of conductive material. The interconnection of these bonding pads relaxes the tolerances required in aligning the connection pads with the bonding pads. This allows a certain amount of geometry tolerance or deformation and pad defects can be tolerated in the assembly process.

[0014] Figure 4 provides an illustration of one embodiment of a process according to the present invention for electrically coupling a flexible circuit assembly to the printed circuit board (PCB). A flexible substrate 401 of the flexible printed circuit assembly is positioned above a circuit substrate 402 of the PCB mounted to the actuator frame 109. The circuit substrate 402 can be rigid or flexible. The bonding pad 403 is mounted on the surface of the circuit substrate 402 and electrically coupled to circuitry within the PCB. The connecting pad 404 is mounted on the surface of the flexible substrate 401 facing the circuit substrate and electrically coupled to circuitry within the flexible circuit assembly. More than one bonding pad 403 can be mounted on the circuit substrate 402 and an appropriate number of connecting pads 404 can be mounted on the flexible substrate 401. The bonding pads 403 and connecting pads 404 can be made of gold, and are appropriately aligned. A ball of metallic material 405 is mounted to each bonding pad 403. The ball of metallic material 405 can be made of gold. Then, a clamping device 406 presses the connecting pads 404 into contact with the gold balls 405. The clamping device can include any of a variety of devices such as a screw and nut,

a pin, or a clip. The gold ball 405 creates an electrical connection between the bonding pad 403 and the connecting pad 404.

[0015] Figure 5 provides an illustration of an alternate embodiment of a process for electrically coupling the flexible circuit assembly to the PCB. The flexible substrate 401 of the flexible printed circuit assembly is positioned above the circuit substrate 402 of the PCB mounted to the actuator frame 109. The bonding pad 403 is mounted on the circuit substrate 402 and electrically coupled to circuitry within the PCB. The connecting pad 404 is mounted on the flexible substrate 401 and electrically coupled to circuitry within the flexible circuit assembly. More than one bonding pad 403 can be mounted on the circuit substrate 402 and an appropriate number of connecting pads 404 can be mounted on the flexible substrate 401. In this embodiment, the bonding pads 403 have solder bumps 501 with a copper core. The bonding pads 403 and connecting pads 204 are aligned. A solder ball 502 is mounted to each bonding pad 403. A clamping device 406 presses the connecting pads 404 into contact with the solder balls 502. As with the embodiment of Fig. 4, the clamping device 406 can include any of a variety of devices such as a screw and nut, a pin, or a clip. The solder ball 502 creates an electrical connection between the bonding pad 403 and the connecting pad 404.

[0016] Figure 6 provides a cross-sectional illustration of one embodiment of the electrical connection of a hard disk drive 601. A flexible substrate 401 of a flexible printed circuit assembly is positioned above a circuit substrate 402 of a PCB mounted to the actuator frame 109. The bonding pad 403 is mounted on the circuit substrate 402 and electrically coupled to circuitry within the PCB. The connecting pad 404 is mounted on the flexible substrate 401 and electrically coupled to circuitry within the flexible circuit assembly. More than one bonding pad 403 are mounted on the circuit substrate 402 and an equal number of connecting pads 404 are mounted on the flexible substrate 401. The bonding pads 403 have solder bumps 501 with a copper core. The bonding pads 403 and connecting pads 404 are aligned. A solder ball 502 is mounted to each bonding pad 403. In this embodiment, the

connecting pads 404 are kept in contact with the solder ball 502 by a screw 602 and nut 603. This electrical connection can be used to electrically couple any two parts of the hard drive, such as the board unit to the spindle motor.

[0017] Figure 7 provides a cross-sectional illustration of one embodiment of the 5 electrical connection of an MP3 player 701. The flexible substrate 401 of the flexible printed circuit assembly is positioned above the circuit substrate 402 of the PCB mounted to the actuator frame 109. The circuit substrate 402 can be rigid or flexible. The bonding pad 403 is mounted on the circuit substrate 402 and electrically coupled to circuitry within the PCB. The connecting pad 404 is 10 mounted on the flexible substrate 401 and electrically coupled to circuitry within the flexible circuit assembly. More than one bonding pad 403 can be mounted on the circuit substrate 402 and an equal number of connecting pads 404 can be mounted on the flexible substrate 401. The bonding pads 403 and connecting pads 404 can be 15 gold pads. The bonding pads 403 and connecting pads 404 are aligned. A gold ball 405 is mounted to each bonding pad 403. In this embodiment, the connecting pads 404 are kept in contact with the gold ball 405 by a spring clip 702.

## What is Claimed is

1. A circuit assembly, comprising:

a circuit substrate with a first set of circuitry;

5 a bonding pad mounted to a surface of the circuit substrate electrically coupled to the first set of circuitry;

a flexible circuit substrate with a second set of circuitry;

a connecting pad mounted to a surface of the flexible circuit substrate facing the surface of the circuit board and electrically coupled to the second set of circuitry;

10 a ball of conductive material mounted on the bonding pad; and

a clamping device to press the connecting pad to the ball of conductive material.

2. The circuit assembly of claim 1, wherein the ball of conductive material is gold.

15 3. The circuit assembly of claim 1, wherein the ball of conductive material is solder.

4. The circuit assembly of claim 1, wherein the bonding pad is gold coated.

5. The circuit assembly of claim 1, wherein a solder bump is placed on the bonding  
20 pad.

6. The circuit assembly of claim 1, further comprising:

a plurality of bonding pads coupled to the surface of the circuit substrate;

a plurality of connecting pads coupled to the surface of the flexible circuit  
25 substrate facing the surface of the circuit board; and

a ball of conductive material mounted on each bonding pad.

7. The circuit assembly of claim 1, wherein the clamping device is one of a group including a screw and nut, a pin, and a clip.

8. A hard disk drive, comprising:

a magnetic disk to contain data;

a slider to contain a magnetic transducer to read data from the magnetic disk;

a head gimbal assembly to suspend the slider above the magnetic disk;

5 a voice coil motor to move the head gimbal assembly in relation to the magnetic disk;

a circuit substrate with a first set of circuitry to control the magnetic transducer and the voice coil motor;

10 a bonding pad mounted to a surface of the circuit substrate electrically coupled to the first set of circuitry;

a flexible circuit substrate with a second set of circuitry;

a connecting pad coupled to a surface of the flexible circuit substrate facing the surface of the circuit board and electrically coupled to the second set of circuitry;

a ball of conductive material mounted on the bonding pad; and

15 a clamping device to press the connecting pad to the ball of conductive material.

9. The hard disk drive of claim 8, wherein the ball of conductive material is gold.

10. The hard disk drive of claim 8, wherein the ball of conductive material is solder.

20

11. The hard disk drive of claim 8, wherein the bonding pad is gold coated.

12. The hard disk drive of claim 8, wherein a solder bump is placed on the bonding pad.

25

13. The hard disk drive of claim 8, further comprising:

a plurality of bonding pads coupled to the surface of the circuit substrate;

a plurality of connecting pads coupled to the surface of the flexible circuit substrate facing the surface of the circuit board; and

a ball of conductive material mounted on each bonding pad.

14. The hard disk drive of claim 8, wherein the clamping device is one of a group including a screw and nut, a pin, and a clip.

5

15. A method, comprising:

mounting a bonding pad to a surface of a circuit substrate;

electrically coupling a first set of circuitry of the circuit substrate;

mounting a connecting pad to a surface of a flexible circuit substrate facing the  
surface of the circuit substrate;

( 10 electrically coupling a second set of circuitry of the flexible circuit substrate;

mounting a ball of conductive material on the bonding pad; and

clamping the connecting pad to the ball of conductive material.

15 16. The method of claim 15, wherein the ball of conductive material is gold.

17. The method of claim 15, wherein the ball of conductive material is solder.

18. The method of claim 15, wherein the bonding pad is gold plated.

20

19. The method of claim 15, wherein a solder bump is placed on the bonding pad.

20. The method of claim 15, further comprising:

coupling a plurality of bonding pads to the surface of the circuit board;

25 coupling a plurality of connecting pads to the surface of the flexible circuit  
substrate facing the surface of the circuit substrate; and

mounting a ball of conductive material on each bonding pad.

## Abstract

An electrical connection and a method of electrically coupling are disclosed. In one embodiment, a circuit substrate with a first set of circuitry has a bonding pad mounted to a surface of the circuit board. The bonding pad is electrically coupled to the first set of circuitry. A flexible circuit substrate with a second set of circuitry has a connecting pad mounted to a surface of the flexible circuit substrate facing the surface of the circuit board. The connecting pad is electrically coupled to the second set of circuitry. A ball of conductive material is mounted on the bonding pad. A clamping device presses the connecting pad to the ball of conductive material.

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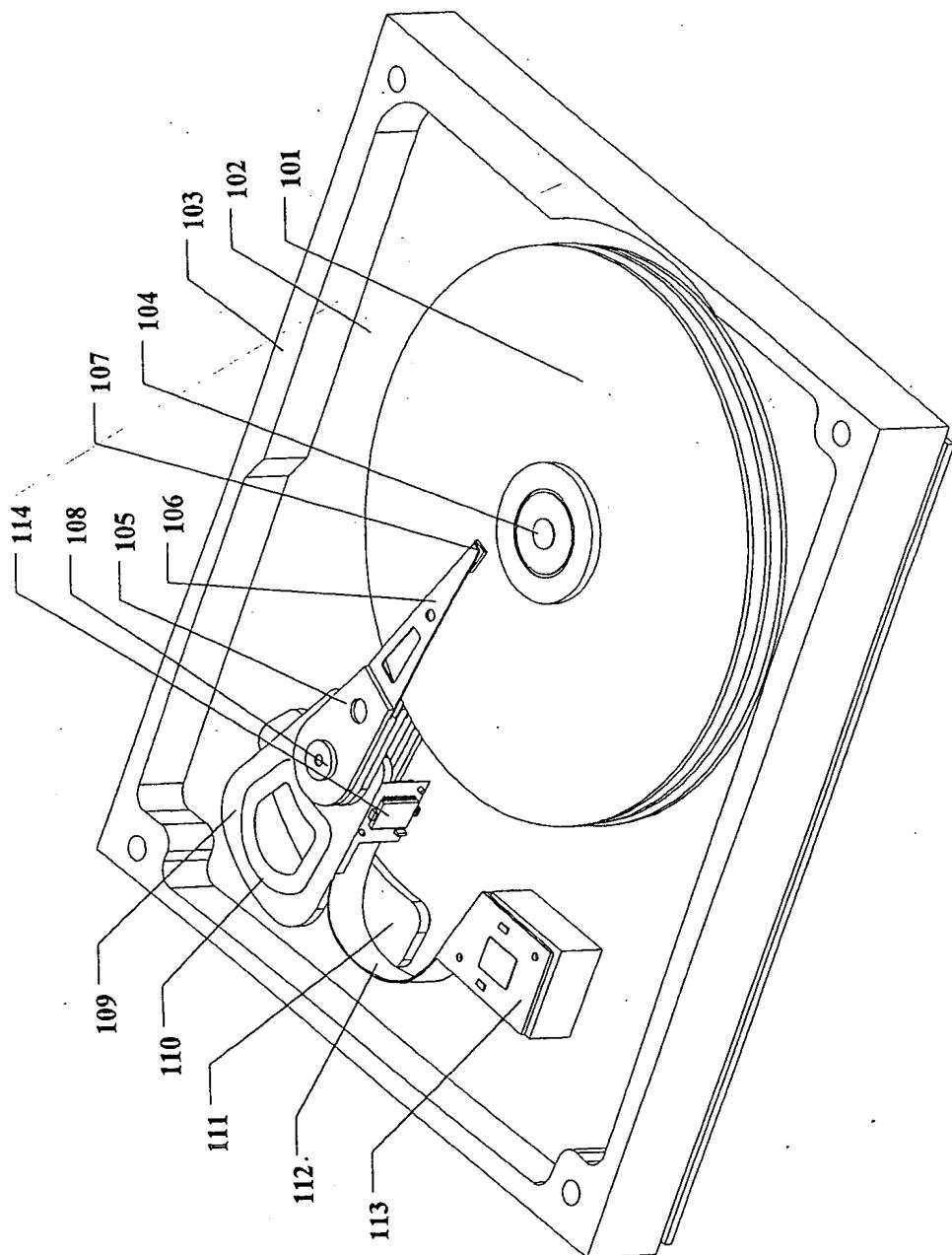


FIG. 1  
(Prior Art)

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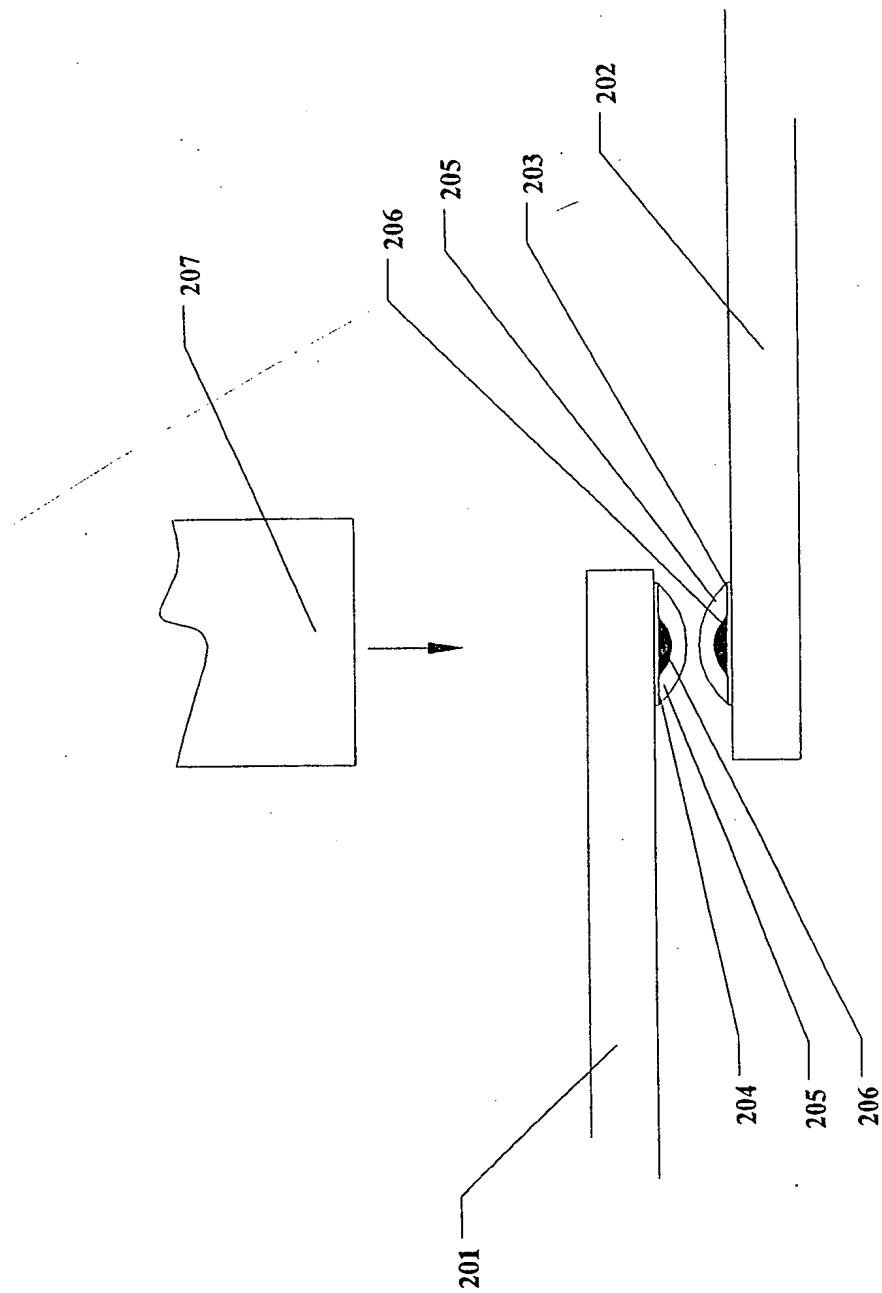


FIG. 2

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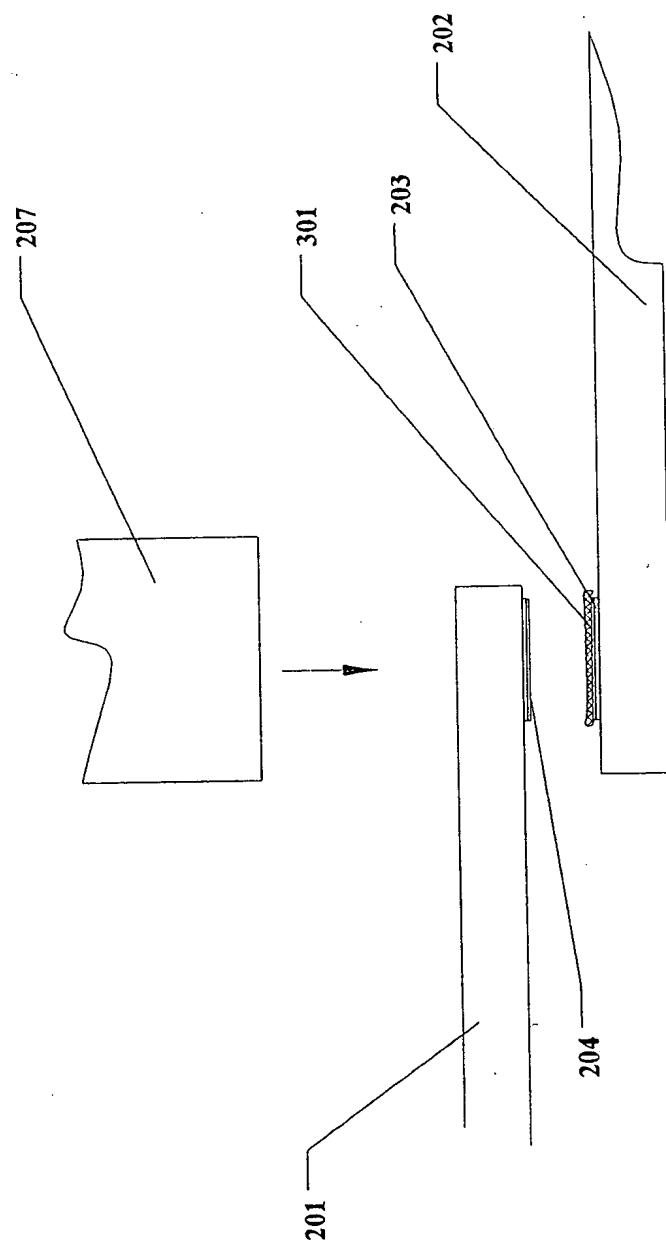


FIG. 3

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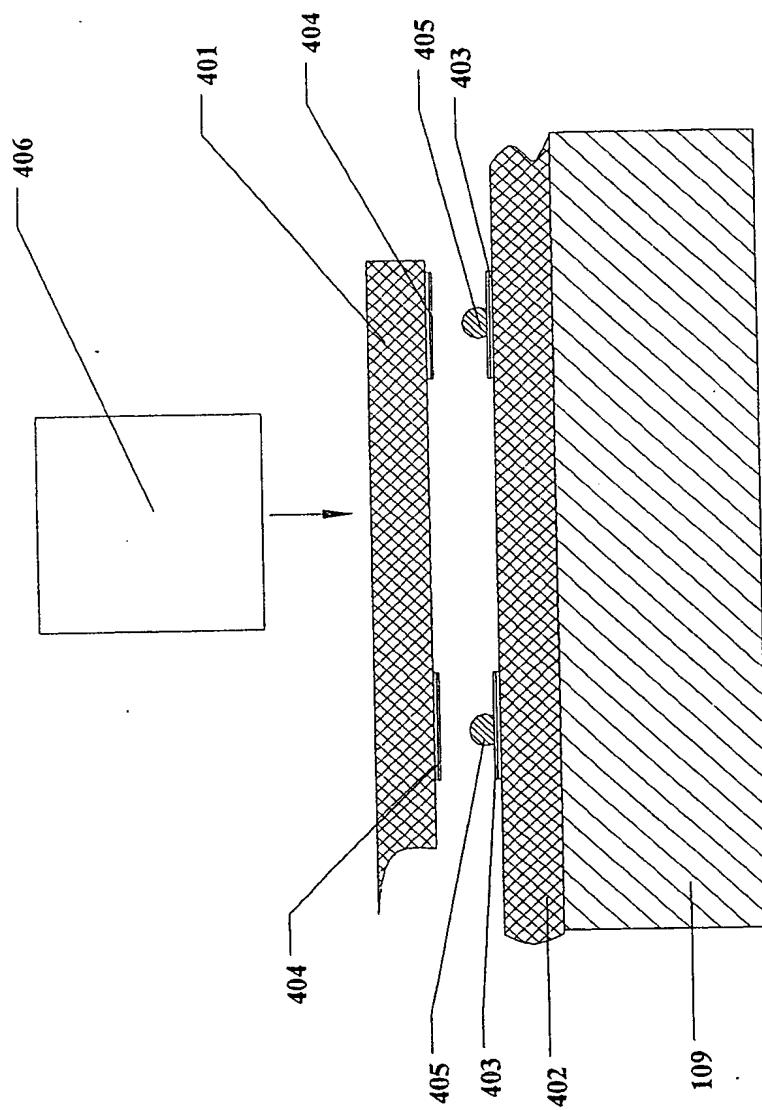


FIG. 4

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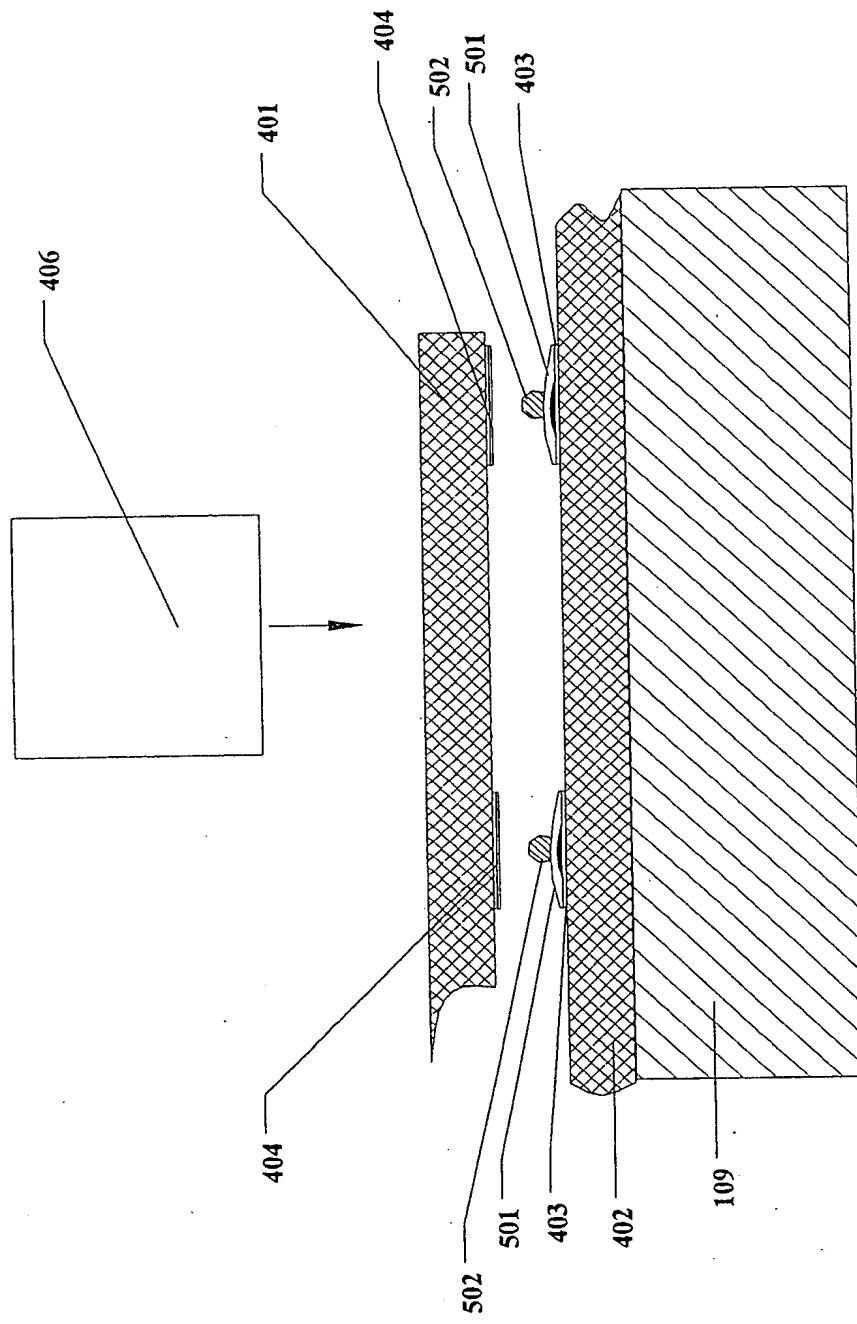


FIG. 5

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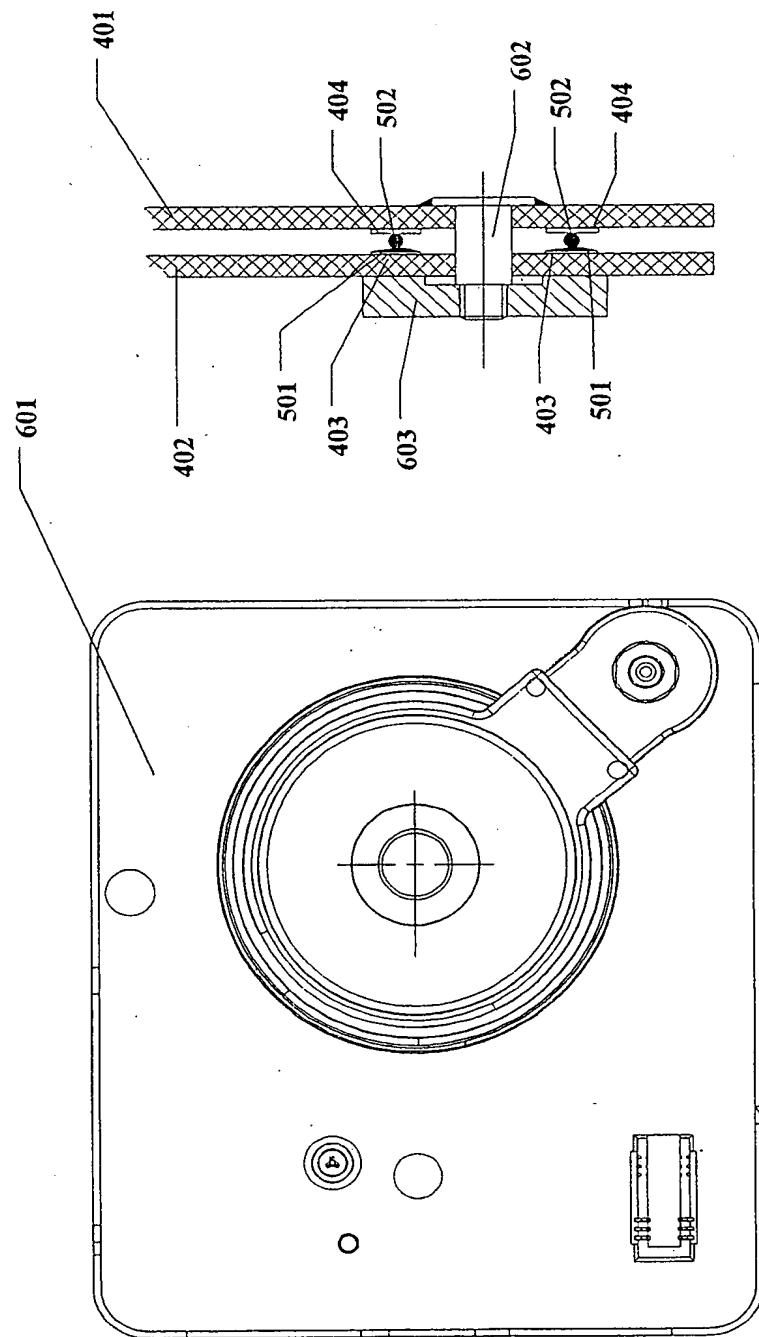


FIG. 6

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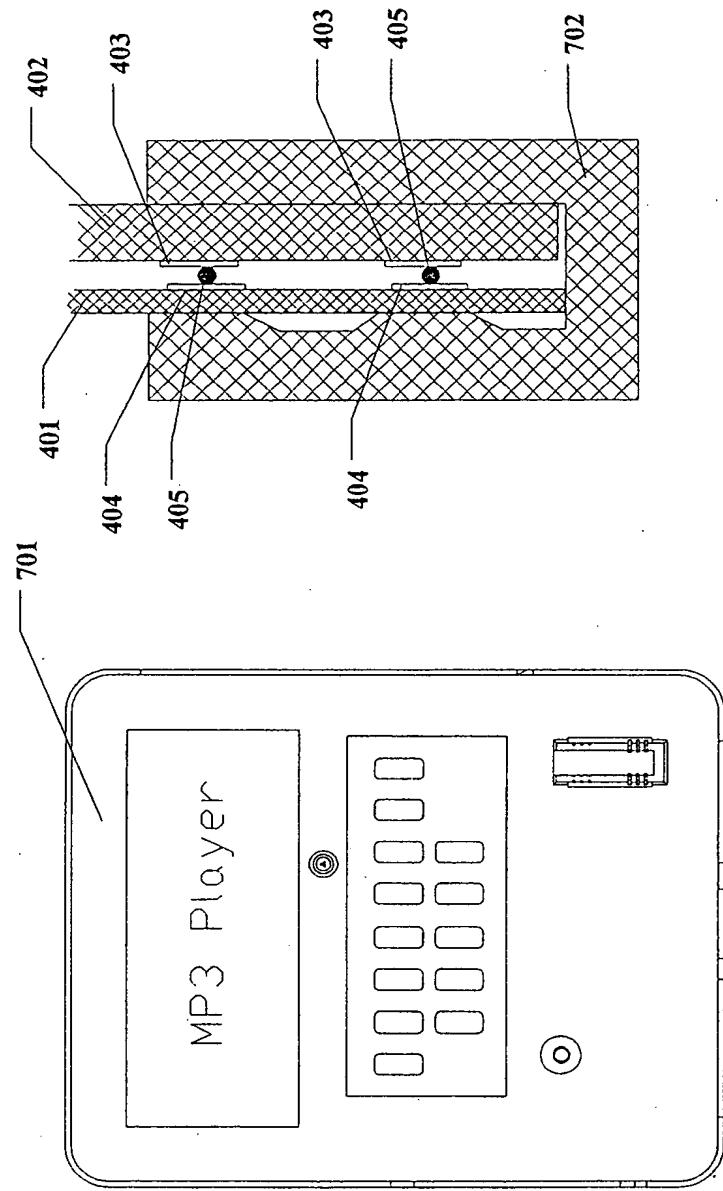


FIG. 7